found that in the ripe ova of *Tubijex*, prior to laying, the spherical germinal vesicle lost its spherical shape, elongated, became spindle-shaped with a meridional striation, and so forth, closely resembling the nuclear spindle of *Nephelis*. But as the process is described by Bütschli this would involve the necessity that the *whole* of the germinal vesicle was extruded as the "Richtungsbläschen" in every case. Against this, however, there are irresistible facts; and in an appendix to the volume the author is bound some sense to admit that there are cases where "a part of the germinal vesicle may remain." If this be so evidently there is missing a link in the chain of observation. Difficulties of an equally complex character present themselves in the collation of these researches with those of other distinguished embryologists which it would be hopeless even to attempt to consider here.

3. That the expulsion of the "Richtungsbläschen" is a result of impregnation must also be abandoned. In the text of this treatise the author earnestly contends for this point nevertheless; and endeavours to dispel the force of the very definite results of Œllacher, Bischoff, Flemming, and Beneden. But these are points that may be settled with comparative ease, and it certainly is true that the expulsion of the "Richtungsbläschen" may show itself as one of the earliest phenomena of development in the unfertilised egg. This is now admitted, and in the appendix is allowed by Bütschli.

4. The universal application of the method of development seen in *Nephelis*, although strongly contended for, and carried by analogy into the interpretation of the theory advanced in the third part of the volume to account for the propagation of Infusoria, can only be admitted with the utmost caution. The evidence given by the author is by no means perfect. In *Cuculanus elegans*, for example, he admits that the transition of the nucleus spindle into the "Richtungsbläschen" cannot be made out as in *Nephelis*, but contends that it *ought not to be doubted*. And precisely the same difficulty attaches to the transformations of the nucleus, of which "nothing could be certainly found;" yet the same doctrine is carried over, as though precisely the same phenomena had been witnessed as in *Nephelis*. So in relation to other Nematoids, it is rather inference than evidence that the protruded vesicle is the germinal vesicle, as in *Nephelis*. So in *Limnæus auricularis*, essential points in the origin and subsequent evolution of the spindle and nuclei are presented, not as the result of observation, but of inference, and a leap across a chasm between two preparations of the ovum which show no continuity of evolution, is taken with an assurance that "doubtless," although the intermediate process was not made out, we might be guided by the analogy of *Nephelis*.

These facts are pointed out, not in the slightest degree to detract from the value of the author's observations, but simply to separate them, as such, from the inferences he draws from them. There can be little doubt that great value belongs to the discovery of the nucleus spindle and its behaviour in evolution; and there can also be little question that it is largely original research; but its relation to anterior and subsequent processes is not so definitely discovered. It is nevertheless a source of great interest to find that Balbiani has given such complete and recent confirmation to the main characteristics of the spindle-nucleus.[1] It is true that he does not confirm the division of the equatorial band in the nucleus, and claims to have shown the existence of the clear spaces and rayings accompanying the nucleus-transformations in the eggs of spiders four years before. But evidently a step is gained by these observations on the earliest development of the ovum; although, from the careful work of M. Fol, it is clear that not only the interpretation, but the detail, may be open to question.[2]

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(To be continued.)

THE ALKALI TRADE

The History, Products, and Processes of the Alkali Trade, including the most Recent Improvements. By Charles Thomas Kingzett. (London: Longmans, Green, and Co., 1877.)

TOWARDS the middle of last century the price of oil of vitriol was 130*l.* per ton; the same substance now sells at 5*l.* per ton. In the first years of the present century soda crystals sold at about 60*l.* per ton; their present price is about 4*l.* 15*s.* per ton.

In 1861 the Lancashire district produced 8,800 tons of soda crystals, 4,600 tons of caustic soda, and 11,700 tons of bicarbonate of soda. The same district consumed, in that year, 161,000 tons of sulphuric acid and 135,000 tons of salt. Five years later (1866) 194,000 tons of salt were consumed in the same district, while the out-put amounted to 25,000 tons of soda crystals, 11,000 tons of caustic, and 6,500 tons of bicarbonate, together with 87,000 tons of soda ash and refined alkali, and large quantities of bleaching liquor, bleaching powder, &c. The following numbers, obtained from the Alkali Association, show the increase in the alkali trade of the United Kingdom between the years 1862 and 1876:—

	1862.	1876.
Annual value of finished products	£2,500,000	£6,500,000
Weight of dry products	280,000 tons.	845,000 tons.
Raw materials used:—		
Salt	254,600 ,,	538,600 ,,
Coals	961,000 ,,	1,890,000 ,,
Limestone and chalk	280,500 ,,	588,000 ,,
Lime	—	139,000 ,,
Pyrites	264,000 ,,	376,000 ,,
Nitrate of soda	8,300 ,,	12,200 ,,
Manganese	33,000 ,,	18,200 ,,
Total	1,801,400 tons.	3,562,000 tons.
Capital employed in the business	£2,000,000	£7,000,000
Hands employed	10,600	22,000
Wages paid them annually..	£549,500	£1,405,000
Weight of soda exported	104,762 tons.	270,856 tons.
Value of exported soda	£885,245	£2,209,284

These facts enable us to form some idea of the enormous growth of the alkali trade within recent years. This growth has been in a large measure coincident with

[1] Sur les Phénomènes de la Division du Noyau Cellulaire, *Comptes Rendus*, Oct. 30, 1876.
[2] Sur les Phénomènes Intimes de la Division Cellulaire, *Comptes Rendus*, Oct. 2, 1876.

the growth of scientific knowledge. The facts discovered in the laboratory have been turned to account in the alkali work, and the theories of the chemist have not unfrequently received confirmation at the hands of the manufacturer. Conversely, the wants of the manufacturer have hastened the discovery of fresh facts, and the success or failure in the application of these facts on the large scale has reacted beneficially upon the advance of chemical theory. In 1750 sulphuric acid was manufactured by distilling sulphate of iron in earthen vessels luted to glass receivers. The destruction of plant obliged the manufacturer to adopt a better method. The chemist supplied him with the facts: Nitre and sulphur when burnt together produced sulphuric acid. The manufacturer supplied the mechanical means for realising this process on the (comparatively) large scale. Soon after this time Scheele discovered chlorine; the manufacturer, acting on the experiments of the chemist, turned to account the fact that chlorine readily combines with hydrogen. But the impulse thus given to the bleaching trade necessitated a corresponding advance in the manufacture of sulphuric acid. The chambers in which the nitre and sulphur were burnt were enlarged, improvements were adopted, and the price of the acid decreased while the consumption increased.

In more modern times we see the need of a cheaper method for manufacturing chlorine, giving rise to the successful process of Weldon, a process based upon strictly experimental laboratory data, and to the hitherto not so successful process of Deacon. We see the failure of the latter process inducing its discoverer to extend his researches, and as a consequence chemical science is enriched with a valuable paper which throws considerable light upon the general principles of chemical dynamics.

While the history of the alkali trade illustrates the benefits conferred upon manufactures by science, and the requital made to science by manufactures, it also forcibly illustrates the uses which to-morrow may bring for the waste products of to-day.

The monopoly granted by the King of Sicily to one firm in the exportation of sulphur obliged the manufacturers of oil of vitriol to have recourse to some other source of sulphur. The introduction of pyrites led to the accumulation of burnt ore, and this again to Henderson's method for extracting copper, a method which, whether considered chemically or commercially, has proved most successful. The hydrochloric acid sent out from the chimney of the alkali works has, since 1863, been almost wholly condensed, and from this once wasted acid immense quantities of bleaching powder are now manufactured. The acid liquors from the manganese still, although rich in manganese, were formerly sent into the nearest stream, thus causing at once a loss to the manfacturer and a nuisance to the neighbourhood. Now, however, these liquors are turned to use, the nuisance is abated, and the manufacturer is enriched.

But if one is to acquire a just idea of the immense dimensions, and of the importance of the alkali trade from a commercial, chemical, or general point of view, one must learn in detail the history of the manufacture, the development of the processes which gather round the alkali trade as their centre, and the connections which subsist between the practical carrying out of the manufacture and the general principles of chemical science. Such a knowledge may be obtained from the work before us. Mr. Kingzett gives a clear and succinct account of the rise of the alkali trade and of the present state of the manufacture. Notices, sufficiently detailed for the purposes of the general reader, of all the recent improvements are introduced. The allied trades, especially the bleaching powder and soap manufactures, are described.

The book necessitates a general knowledge of chemistry on the part of the reader, inasmuch as processes are everywhere referred to their fundamental chemical principles. He who wishes for a rule of thumb acquaintance with the alkali manufacture will certainly find the information given in this work beyond his scope. On the other hand, the man who, having a general knowledge of chemistry, really wishes to learn how chemical facts are turned to account in manufactures, and also how mechanical difficulties are overcome, cannot do better than study—not read only—the work before us.

The chemical manufacturer also may gain from this work a more extended knowledge of his trade, and he may receive many hints, which, if he be of an inventive turn of mind, he may some day turn to account. The author has evidently endeavoured to treat the subject from the standpoint of the scientific manufacturer, and we think he has very fairly succeeded.

Full details of the more modern improvements of Hargreaves, Mactear, and others in the manufacture of alkali are given. The Weldon process for manufacturing bleach is described minutely, the improvement suggested by Mr. Weldon, whereby loss of calcium chloride would be avoided, is mentioned, and its utility is pointed out.

Of course there are parts of the book which it appears to us admit of improvement. The introduction of an index would add to the value of the work. Might we suggest to Mr. Kingzett that it would be well to re-write the preface, and generally those portions of the work in which he indulges in philosophising? The book begins with a platitude: "The wealth of a nation may be said to be indicated by the magnitude of its commerce." It closes (the last chapter is purely statistical) with a poor simile: "Life may be compared to a spectrum with its bright and dark lines."

M. M. PATTISON MUIR

OUR BOOK SHELF

River Terraces. By Col. George Greenwood. (London: Longmans and Co.)

FOR somewhere about fifteen years no name occurred more frequently in the geological correspondence of our magazines and newspapers than that of "George Greenwood, Colonel," and no letters carried with them a more marked individuality than those to which that name was appended. They never betrayed any doubt or hesitation, but made merry over the doubts and difficulties of other and more experienced observers; they showed in vigorous language that in so far as a correspondent agreed with their author, he was right, that in so far as he differed he was wrong. Fathers in science like Lyell and Darwin, as well as striplings, not yet emancipated from geological long-clothes—one and all needed instruction and correction at the hands of the enthusiastic Colonel. He spoke of the